THE HYDROACOUSTIC NETWORK, INTERNATIONAL MONITORING SYSTEM: STATUS AND PLANS

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ABSTRACT

The hydroacoustic network is one of the monitoring networks of the International Monitoring System (IMS) established under the Comprehensive Nuclear-Test-Ban Treaty. The Signatory States of the Comprehensive Nuclear-Test-Ban Treaty have formed a Preparatory Commission to oversee Treaty-related activities until the Treaty enters into force. The Preparatory Commission has established technical requirements, certification standards, and draft operational practices for the hydroacoustic network. The Hydroacoustic Monitoring Section of the IMS Division of the Preparatory Commission's Provisional Technical Secretariat is responsible for the establishment, certification, and operation of the hydroacoustic stations according to Commission's requirements and standards.

The IMS hydroacoustic network, designed to monitor the major world oceans, contains eleven stations located with an emphasis on the vast ocean areas of the Southern Hemisphere. Two quite different sensing techniques are employed in the hydroacoustic network; hydrophone sensors, which effectively cover large ocean areas, but are quite complex and expensive, and seismic detectors on small islands which are less effective, but considerably simpler and cheaper.

At the introduction of the CTBT, three of the planned hydroacoustic network stations existed, leaving the remaining eight stations to be totally new installations. However, the upgrades required to bring the existing stations up to the specified standard are such that the work required on these stations will be similar to that for new installations. The establishment of each hydroacoustic station requires a survey to ensure the suitability of the site and to assist with installation planning, followed by the installation of new equipment, and then a period of testing leading finally to certification that the station meets the specified standards. Site surveys have been completed, or are underway, for seven of the stations and two additional surveys are planned to begin during 2000. Equipment has been installed at two new hydrophone stations and one new island seismometer station. Work is underway on the installation of another hydrophone station.

Key Words: International Monitoring System, Hydroacoustic

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INTRODUCTION

The hydroacoustic network is one of the monitoring networks of the International Monitoring System (IMS) established under the Comprehensive Nuclear-Test-Ban Treaty. The Signatory States of the Comprehensive Nuclear-Test-Ban Treaty have formed a Preparatory Commission to oversee Treaty-related activities until the Treaty enters into force. The Preparatory Commission has established technical requirements, certification standards, and draft operational practices for the hydroacoustic network. The Hydroacoustic Monitoring Section of the IMS Division of the Preparatory Commission's Provisional Technical Secretariat is responsible for the establishment, certification, and operation of the hydroacoustic stations according to Commission's requirements and standards.

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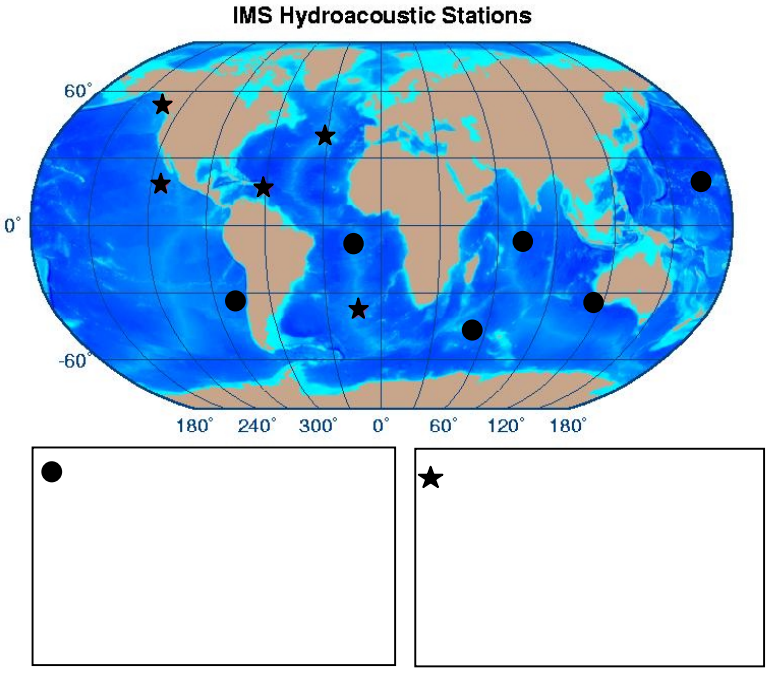
This paper presents a brief overview of the IMS hydroacoustic network and describes the two types of stations, namely the T-phase and hydrophone stations. The present status of the network implementation is outlined. Examples of station data are used to show the typical noise background and the types of signals expected.

THE HYDROACOUSTIC NETWORK

The existence of the SOFAR channel (Sound Fixing and Ranging) makes the ocean a remarkably efficient medium for the transmission of sound energy. Thus the signal generated by an explosion occurring in the water, above water in the low atmosphere, or underground near shore will be detected effectively even at long distances by sensors located in the SOFAR channel.

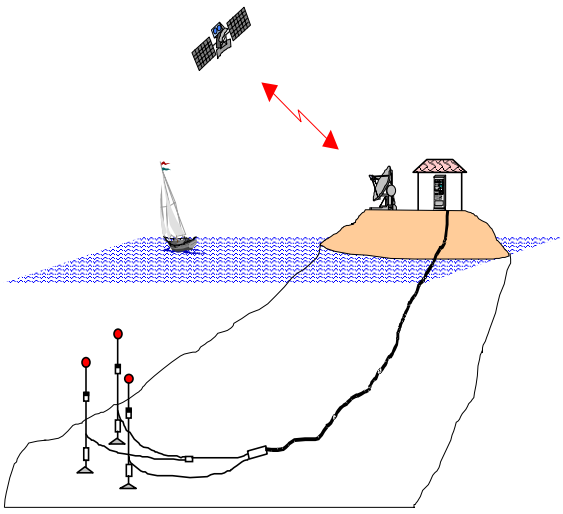


In order to detect the acoustic energy ducted through the SOFAR channel a network composed of 11 hydroacoustic stations is being implemented. Six stations will be equipped with hydrophone sensors. The other five hydroacoustic stations are located on small, steep-sloped islands and will make use of seismic sensors to detect waterborne energy, which is converted to a seismic wave at the boundary of the island. This type of propagation has long been known to the

seismic community as T-phase propagation. T-phase stations are not as effective in detecting and identifying hydroacoustic signals from explosions, but they are considerably less expensive than hydrophone stations. The mixture of hydrophone and T-phase stations selected for the IMS hydroacoustic network was chosen to provide a cost-effective compromise. The network is shown on the map, in which the stations are listed in order from west to east.

HYDROPHONE STATIONS

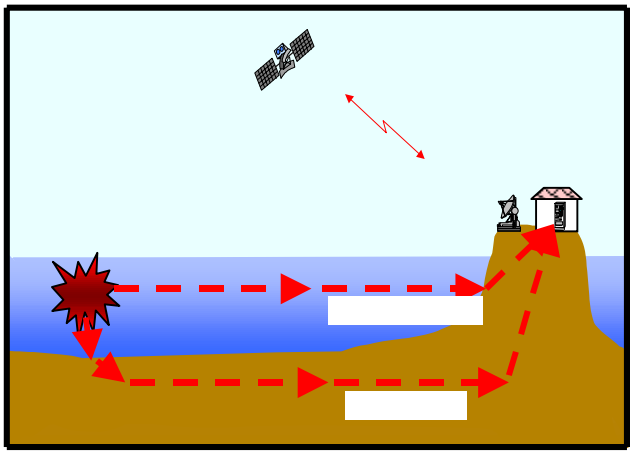
All hydrophone stations, except for Cape Leeuwin, are located on relatively small islands. They generally consist of two undersea trunk cables, each with three hydrophone sensors. To avoid bathymetric blockage by the island, cables and sensors are deployed on opposite shores of the island. Each hydrophone sensor has an independent wet-end digitizer. The digital signals are transmitted to the shore facility via a non-repeatered fiber optic cable for processing and transmission by satellite to the IDC in Vienna (see figure).



The hydrophone sensors are placed at or near the axis of the SOFAR channel, using a subsurface float and an ocean-bottom anchor. In order to provide the station with some directional capabilities, the three hydrophones are placed in a triangular configuration and each sensor is separated horizontally by a distance of approximately two kilometers.

T-PHASE STATIONS

A T-phase station uses seismometers that are located to detect seismic waves generated by the coupling of waterborne energy along the flanks of the island. Each station is composed of one to three seismometers and a data acquisition system. As in the case of the hydrophone stations, the data are formatted and transmitted by satellite in real time to the IDC. The figure shows, in schematic form, a typical T-Phase Station including the seismic and hydroacoustic signal paths from an underwater event, the shore facility (sensor) and the satellite link to the IDC in Vienna.



STATION STATUS AND PLANS

The establishment of each IMS hydroacoustic station requires a survey to ensure the suitability of the site and to assist with installation planning, followed by the installation of new equipment, and then a period of testing leading finally to certification that the station meets the specified standards.

A brief description follows of the station status and plans for each of the eleven stations of the hydroacoustic network.

HA01 Cape Leeuwin
This station is a totally new hydrophone based station, situated at the south-west corner of Australia. It will have a single triplet of hydrophones (all other hydrophone stations have two triplets). The site survey for this station is complete. Manufacture is underway, with installation expected around April 2001.

HA02 Queen Charlotte Islands
This is a T-phase station that existed before the CTBT was opened for signature. It is situated off the Pacific coast of Canada. However, the station needs a substantial upgrade to bring it to CTBT specifications. The field work for the site survey is complete. The site survey report is in preparation. Installation is planned to take place in 2001.

HA03 Juan Fernandez Island
This station is a totally new hydrophone based station, situated off the coast of Chile. Proposals for performing the site survey are currently being examined. Installation is planned to take place in 2003.

HA04 Crozet Island
This station is a totally new hydrophone based station, situated in the French Austral Territories in the south-west of the Indian Ocean. The site survey and manufacture for this station are complete. The shore facility and the underwater cable are installed, as are one triplet of hydrophones. Completion of the installation is planned to take place in January 2001.

HA05 Guadeloupe
This is a totally new T-phase station, situated in the French Antilles. It will have two 3-component broad-band seismometers, one on Desirade and one on Martinique. The site survey for this station is complete. Installation of one seismometer is complete and data is being sent to Vienna. Installation of the other seismometer is planned to take place in September 2000.

HA06 Socorro Island
This is a totally new T-phase station, situated off the Pacific coast of Mexico. The site survey for this station is complete. The site survey results are currently being examined in detail, in particular to decide on whether to have 2 or 3 seismometers and also on exactly where to locate them. Installation is planned to take place in 2001.

HA07 Flores Island
This is a totally new T-phase station, situated in the Azores in the northern Atlantic Ocean. The field work for the site survey for this station is complete. The site survey report is in preparation. Installation is planned to take place in 2002.

HA08 Chagos Archipelago
This station is a totally new hydrophone based station, situated at Diego Garcia in the northern Indian Ocean. The site survey and manufacture for this station are complete. The station was installed in April 2000. The communications link to Vienna should be complete in September 2000.

HA09 Tristan da Cunha
This is a totally new T-phase station, situated in the southern Atlantic Ocean. Proposals for performing the site survey are currently being examined. Installation is planned to take place in 2003.

HA10 Ascension Island
This is a hydrophone based station that existed before the CTBT was opened for signature. It is situated in the mid Atlantic Ocean. Unfortunately a cable break has made this station inoperative. Further, the station needs a substantial upgrade to bring it to CTBT specifications. Work is expected to begin in 2001, leading to installation in 2003.

HA11 Wake Island
This is a hydrophone based station that existed before the CTBT was opened for signature. It is situated in the north-west Pacific Ocean. However, the station needs a substantial upgrade to bring it to CTBT specifications. Work is expected to begin in 2002, leading to installation in 2004.